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ARS SPECIAL REPORT

Mucosal Disease Complex

A Group of Cattle Diseases

ARS 22-27

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June 1956

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Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE

SUMMARY

This report summarizes available information concerning a group of four cattle disease conditions known as the mucosal disease complex. Much of the research on the complex is preliminary and findings reported at this time should not be considered as final.

Most of the studies and observations on the diseases have been made in the various States where the conditions have been found. No attempt is made here to relate results of research to the specific State where the studies were made. Several industrial research groups are conducting additional studies and helping to support research on the complex in the States.

This report is based in part on material reported at meetings of research workers and veterinarians held to exchange information on the component diseases of the complex.

Information in this report was provided by the Animal Disease Eradication Branch and the Animal Disease and Parasite Research Branch, Agricultural Research Service

MUCOSAL DISEASE COMPLEX

(A Group of Cattle Diseases)

A group of clinically similar disease conditions in cattle of potential importance as a threat to the cattle industry of the United States have been reported from 30 States since 1946. These diseases are considered here collectively as the mucosal disease complex. Effects of the component diseases vary, but in some areas severe losses in weight and milk production as well as heavy death losses have been suffered. There is no evidence that any of the diseases affect human beings.

Complete knowledge of the characteristics of the diseases is not available, but considerable research work is being done in States where the infections have appeared. Some work on the complex, including research and diagnostic identification, has been carried out in about 20 States. This report summarizes preliminary information that has been determined by observation and from the various studies.

CONSIDERED TO BE VIRUS DISEASES

Research workers are generally agreed that the mucosal complex includes at least four separate conditions. These have been identified as (1) rhinotracheitis, (2) mucosal disease, (3) virus diarrhea, N. Y., and (4) virus diarrhea, Ind. They are contagious, febrile diseases characterized by nasal and lachrymal discharges, salivation, similar lesions and congested areas on mucous membranes of the digestive or respiratory tracts, and diarrhea. All are believed to be caused by a virus. It is not clear at this time whether four separate viruses or several strains of one or more viruses are involved. Rhinotracheitis differs so markedly from the other conditions of the complex that it is believed to be caused by a different virus. The other three conditions may or may not be caused by variants of the same virus. Immunity to one of the four diseases does not provide immunity against any of the others.

RINDERPEST RULED OUT

Some symptoms and lesions of the diseases closely resemble rinderpest, the dreaded cattle disease that causes serious losses in other parts of the world. To make certain that rinderpest had not broken out in this country, the Agricultural Research Service on several occasions has arranged for tests to be made at a foreign laboratory where research work is being conducted on rinderpest. [1] The results have shown that the diseases of the complex are not rinderpest.

The first test was made on material collected during the initial appearance of a new disease in New York in 1946, later known as virus diarrhea, N. Y. The second test was made on material collected from outbreaks of the complex in five States. The latest test was run on live cattle shipped from the United States. The shipment was made up of four groups of two

[1] No research on rinderpest is being conducted in the U. S. at present.

animals. Each group was immune to a different disease of the complex, thus providing the means of checking all the diseases against rinderpest. The Agricultural Research Service will continue to arrange for additional tests from time to time to make certain the existence of the mucosal disease complex does not mask an outbreak of rinderpest.

The Agricultural Research Service also arranged for Dr. Stanley E. Piercy, Assistant Director of the East African Veterinary Research Organization, Kenya, East Africa, to accompany ARS veterinarians to California and investigate an outbreak of rhinotracheitis. Considerable research on rinderpest has been conducted in East Africa because of the widespread incidence of the disease on that continent. Dr. Piercy stated that the disease did not seem to be any of the similar diseases which occur in East Africa, such as rinderpest, malignant catarrh, Rift Valley fever, and pleuropneumonia.

DISTRIBUTION OF DISEASES

Rhinotracheitis More Widespread in the West

Rhinotracheitis was first observed in Colorado in 1950 and has now appeared in Arizona, California, Colorado, Idaho, Nebraska, New Mexico, Utah, and Wyoming. The disease may have occured in other States.

Of the four diseases in the complex, rhinotracheitis is presently considered to be the most important economically because it has spread through western feed lots where large numbers of animals have been affected. Its principal effect is serious loss of weight in infected animals. Death losses are reported between 1 and 3 percent of infected animals. By 1955 it was considered the most serious disease among feed-lot cattle in Colorado.

Rhinotracheitis affects the respiratory system and has also been called "red nose," "rhinitis," "necrotic rhinitis," "upper respiratory disease," and "California influenza-like disease of cattle" in that State.

Other Conditions Widely Scattered

Mucosal disease has been recognized in 24 States--Alabama, California, Delaware, Georgia, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Montana, Nebraska, New York, North Dakota, Ohio, Oregon, Pennsylvania, South Carolina, South Dakota, Texas, Virginia, Washington, and Wisconsin. Iowa reports a greater incidence than any other State.

The two forms of virus diarrhea have been reported from California, Indiana, Minnesota, New York, and Ohio. Most of these have been isolated cases rather than widespread outbreaks.

The first recognition of any form of the complex was reported in New York in 1946, now called virus diarrhea, N. Y. The disease called virus diarrhea, Ind., first appeared in Indiana in 1953, and mucosal disease was first recognized in Iowa in 1951.

These three diseases usually affect the digestive system, but in some cases both the digestive and respiratory tracts are involved. It is not

entirely clear at this time if one disease causes this "lap-over" of symptoms, or if the animals observed were suffering from two of the diseases in the complex at the same time.

Some States report that the digestive forms of the complex do not cause severe losses. Other States report high rates of mortality and morbidity (percentage of diseased animals in a herd or area in a single outbreak) and serious loss of condition in animals that survive. Iowa has reported heavy death losses from mucosal disease. However, recent observations in Indiana indicate that subclinical or inapparent cases of the digestive diseases are more common than was previously supposed.

NO EFFECTIVE TREATMENT

No successful method for treating any of the diseases has been developed. Most of the antibiotics used in combating diseases have been tested with inconclusive results. These drugs probably do help to keep down complicating secondary infections.

INCIDENCE BELIEVED WIDER THAN REPORTS INDICATE

Disease eradication officials believe that the complex is probably more widespread than confirmed reports indicate, because (1) the complex has been recognized so recently, and (2) the symptoms are similar to other diseases. However, Federal and State animal disease eradication authorities in each State either have had experience with one or more diseases of the complex, or have been informed about them and alerted to the possible threat of their spread. Confirmed diagnoses are being reported to the Agricultural Research Service, Animal Disease Eradication Branch, which will provide more complete information on the incidence and spread of these diseases as it is compiled.

RESEARCH PROGRESS

Major progress in the research studies on the disease complex may be summarized as follows:

(1) All four conditions can be experimentally transmitted. When the disease conditions were first recognized, research was handicapped because scientists were unable to transmit the infection to experimental animals for controlled study. Methods have since been developed whereby the diseases can be readily transmitted with various materials and tissues. Blood samples and, in the case of rhinotracheitis, nasal washings have been used most frequently.

(2) The causative agent of each condition is believed to be a virus. Identifying the causative organism is an important step in leading the way toward determining methods of combating the diseases.

(3) The four conditions are immunologically different. Animals that have developed immunity to one condition in the complex are not immune to the others.

(4) Tests have been developed to differentiate between the conditions. Animals are now available that are immune to one and only one of the four diseases. That is true for the identified diseases of the complex. Therefore,

it is possible to test for each condition and differentiate from the other three.

(5) Studies have indicated that the causative agent of at least two conditions may be grown on tissue culture. Preliminary studies indicate that the virus of both virus diarrhea, Ind., and rhinotracheitis can be grown on tissue culture. This may provide a useful tool for diagnosis and also permit further studies on the development of an immunizing product. At the present time the only method for growing virus and for diagnosis is by injecting disease-free live cattle, which usually must be obtained and held for this purpose. Tissue culture propagation of virus is a relatively simple procedure, once the method is perfected.

RHINOTRACHEITIS--SYMPTOMS AND EFFECTS

Rhinotracheitis affects the nasal passages, larynx, trachea, and sometimes the lungs. Associated lung lesions, when present, are usually secondary, but can be fatal.

Incubation period in experimentally infected animals is 3 to 4 days. Methods of normal spread are undetermined but test animals can be infected by spraying the virus into the trachea.

Clinical Symptoms

In dairy cattle the first clinical symptom (effect of the disease observed in live animals) is a sharp reduction in milk flow, followed in about 12 hours with salivation and a thin, watery nasal discharge. In beef cattle the salivation, nasal discharge and coughing are normally the first symptoms that are observed.

Temperature rises to about 103 to 108 degrees or even higher. There is marked respiratory distress with rapid, shallow mouth breathing and perhaps a dry cough. As the disease progresses there may be a deep bronchial cough. The nasal discharge becomes thicker, and difficulty in breathing increases, until death may be caused by strangulation from the exudate blocking breathing passages.

Diarrhea has been observed in some cases of rhinotracheitis, but it is not typical or common.

Pregnant animals may abort when affected by the disease.

Dehydration is severe, with weight losses of as much as 1/4 to 1/5 total body weight. The coat of affected animals is dry and rough. Eyes may be inflamed.

The course of the disease may be light, lasting only about 2 to 7 days, followed by recovery. Or it may become chronic, growing progressively more serious in its effects. Chronic cases are frequently fatal.

Pathological Symptoms

Pathological symptoms of the disease (effects upon the tissues observed in post-mortem examination) show that the effects are limited to

the respiratory system. There is considerable congestion of blood on the muzzle, which gave rise to the term "red nose." A thick, cheesy exudate is found between the bones of the nose and over the mucosa of the larynx and trachea. Evidence of pneumonia may be found, particularly if pieces of the exudate have been dislodged and reached the lung.

Morbidity and Mortality

Reports of morbidity and mortality rates vary widely. In California in 1955 the estimated morbidity rates in rhinotracheitis ranged from 20 to 60 percent in dairy cattle and 5 to 30 percent in beef cattle. In Colorado an average morbidity rate of 17 percent was reported in feed lot cattle.

Mortality rates are reported ranging from 1 to 3 percent of the affected animals. But in one lot of aborting heifers the mortality rate was 50 percent. This wide variance indicates that more statistical information is needed before an accurate estimate can be made of these factors.

Economic Importance

Full reports of the economic impact from all affected areas are not yet available, but cattlemen in Colorado consider rhinotracheitis a disease of primary importance in feed lots. Cattle feeders in the State have organized the Colorado Cattle Feeders Association in order to combine forces in combating the disease. The Association has employed a veterinarian to work with the School of Veterinary Medicine and the State Agricultural Experiment Station to study rhinotracheitis. In the feed-lot area of the State, during 1954 and 1955 it was estimated that there had been about 40,000 cases causing an estimated loss of $2,000,000.

Resembles Other Diseases

Although the disease was recognized first in 1950, it is believed that rhinotracheitis had been appearing for some time before then. It closely resembles some of the aspects of the shipping fever complex and cases of rhinotracheitis probably have been reported as shipping fever. One of the recognizable differences is the time at which the disease breaks. Rhinotracheitis does not usually appear until the animal has been on feed for about 30 to 45 days. Shipping fever usually breaks while the animal is in transit or soon after its arrival at the feed lot.

Rhinotracheitis also resembles malignant catarrhal fever and other respiratory conditions. In some cases rhinotracheitis has been confused with bloat when the trachea becomes so clogged that digestion is disturbed.

MUCOSAL DISEASE--SYMPTOMS AND EFFECTS

Mucosal disease is an infection primarily of the digestive tract. It affects both dairy and beef cattle. The disease most frequently affects young animals between the ages of 6 to 14 months, but older animals have been infected. Seasonal incidence in Iowa has been greatest in winter and early spring, especially in the months of February and March. However, it has occurred in every month in the year.

Clinical Symptoms

First symptoms are a rise in temperature to about 106 degrees for 2 or 3 days, and then a drop to nearly normal. There is depression, lack of appetite, nasal discharge, and watery diarrhea. Later the diarrhea becomes severe and is frequently mixed with mucus and blood. Affected animals are markedly emaciated and dehydrated, with a rough, dry hair coat. Often there is increased salivation and lacrimation, and slightly opaque corneas.

Ulcers often can be found on nostrils, muzzle, lips, gums, and in the mouth. Sometimes a foul-smelling exudate hangs from nostrils and muzzle. In some affected herds, there have been foot lesions and marked lameness. These lesions are usually crusted exudate on the skin above the coronary band and a dermatitis between the dew-claws and heels.

Pathological Symptoms

There are lesions, which can be ulcers, cysts, or eroded patches, on the skin of the mouth and the mucous membrane of the alimentary canal. Sometimes there are congested areas and hemorrhage in the colon. The respiratory system is not usually involved.

Morbidity and Mortality

Morbidity rates have ranged from 2 to 50 percent. Mortality rates in animals with recognizable symptoms of the disease are extremely high, from 95 to 100 percent. In Iowa it is known as a "killer."

One of the unusual aspects of morbidity in an affected area is the pattern of spread. Outbreaks have occurred 5, 10, and 20 miles apart with no traceable connecting link. Furthermore, there have been no re-occurrences of mucosal disease on affected farms in later months or succeeding years. This may--or may not--indicate the possibility of non-clinical or inapparent infection with resulting immunity build-up in affected herds.

Economic Importance

The full economic impact is not clearly indicated yet, but individual cattle owners have suffered severe losses from mucosal disease. Since it was first observed at Iowa State College in January 1951, the disease has spread throughout the State and to many adjoining States. At least 20 States have reported the disease so far. By 1955 it was estimated that 400 or more Iowa farms had experienced outbreaks of mucosal disease. Because of the very high mortality rates in recognizable cases of this disease, it could become of primary economic importance if it continues to spread in virulent form.

Resembles Other Diseases

Mucosal disease is similar in symptoms to hyperkeratosis, coccidiosis, virus diarrhea, N. Y., virus diarrhea, Ind., bovine malignant head catarrh, and ulcerative dermatitis of calves.

VIRUS DIARRHEA, IND., AND VIRUS DIARRHEA, N. Y.-- SYMPTOMS AND EFFECTS

The two virus diarrhea diseases, although separate entities, are similar enough to warrant discussing them by comparison.

Both diseases affect the respiratory and digestive systems of beef and dairy cattle. The effects upon the respiratory system are more marked in virus diarrhea, Ind., than in virus diarrhea, N. Y. In fact, effects of the strain identified in New York are generally milder than those of the Indiana strain. But cases of both diseases range from mild to severe and fatal.

Clinical Symptoms

Early indications of both infections are marked depression of the animal followed within several days by a nasal discharge. Mouth lesions, superficial in character, appear very early. The most characteristic symptom of the disease is diarrhea. Early in the course feces are very hard, later becoming fluid and containing mucus and blood. Temperatures are high, ranging up to 104 to 108 degrees. Heart beat and respiration are rapid.

In the Indiana form a small percentage of animals affected with the disease show signs of foot lesions and lameness. There has been no lameness observed in virus diarrhea, N. Y.

Weight losses from virus diarrhea, Ind., are extremely heavy, ranging as high as 1/4 to 1/3 of total body weight. Dehydration is often severe. There is a marked reduction in milk production in infected dairy cattle.

Pathological Symptoms

Pathological observations have shown reddening in the inner wall of nose and trachea in the Indiana type. This effect is not found as often in the New York type. There is congestion, hemorrhages, and erosion of the mucosa of the digestive tract in both diseases.

Morbidity and Mortality

Early reports of virus diarrhea, Ind. showed rather low morbidity rates, but in later cases morbidity has been very high. Sometimes entire herds are affected. Early reports of virus diarrhea, N. Y. showed high morbidity and low mortality. Later reports show low morbidity and high mortality, with 50 percent deaths in clinical cases. Early data showed from 0 to 20 percent of the cases were fatal. Later, reports from Indiana show over 50 percent mortality in a few herds.

Economic Importance

Economic importance of the two diseases is still uncertain, but, as in mucosal disease, individual losses have been severe.

Resembles Other Diseases

Both virus diarrhea diseases resemble epizootic enteritis, first reported from Sweden in 1946, and mucosal disease.

ACTION TAKEN TO COMBAT THE COMPLEX

In February 1955 research scientists and veterinarians from affected States met at the invitation of the Agricultural Research Service at Purdue University to discuss their problems concerning the new diseases. The objectives of the meeting were:

(1) To summarize available information on all of these conditions; (2) to bring research workers together so that they could exchange information freely and make plans for exchange in the future; and (3) to correlate research so the progress could be more rapid and more efficient.

The scope of the problems was explored, and specific recommendations were made concerning the direction future studies should take. Committees were set up to coordinate work under way in the various States and to encourage the initiation of additional research.

Disease incidence continued to spread, and the economic importance of rhinotracheitis in the West became more apparent. Therefore, it was decided to compare experiences again. The Agricultural Research Service invited State and Federal disease control officials as well as research workers to meet at Denver in July 1955.

It was revealed at this meeting that the diseases of the complex then existed in over 20 States and several thousand cattle were affected. The committees set up at the Purdue meeting were enlarged and their duties were redefined. A national coordinating committee of 10 members was also formed. The duties of this committee are:

1. Through recommendations, assist in the allocation of available funds for local and regional research.

2. Explore the availability of laboratory facilities and personnel which could serve as the reference laboratories to aid in differential diagnosis.

3. Assist in the coordination of the work between the reference laboratories.

4. Collect and aid in the exchange of information between workers and control agencies.

5. As definite methods of differential diagnosis become available, investigate and report on the incidence of each condition of the complex.

Purdue University was selected as the reference laboratory to work on the two virus diarrhea diseases and mucosal disease, and Colorado A. and M. College as the reference laboratory for rhinotracheitis. To help support this work, grants of Federal funds were made to both

institutions through the Agricultural Research Service. Funds have also been granted to the California Agricultural Experiment Station to continue cooperative Federal-State research studies already underway there.

The two reference laboratories serve as differential diagnostic centers only for other research groups working in this field. They are not equipped to test samples from other sources. They do serve as storage repositories for established strains of the virus for the diseases with which each is working.

The Agricultural Research Service will aid in obtaining approval for and assist in the transportation of all infectious materials moving between laboratories. The ARS is also aiding reference laboratories in serving as centers for the exchange of information on their respective diseases and will assist in coordinating the work conducted by all interested research groups and facilitate the exchange of information between them.

Reference material on all the conditions and similar, possibly related, conditions are compiled by ARS and sent to State and Federal regulatory officials. Sets of slides for study, showing pathology of the various diseases, are being sent to all ARS field stations.

The State Agricultural Experiment Stations of the North-Central Region are coordinating their research on the complex through a regional research project. In at least one other region, a similar project is being considered.

OBJECTIVES OF RESEARCH

Research by the various groups working on the mucosal disease complex is aimed in general toward the following objectives:

1. To describe more accurately the clinical and pathological features of the diseases in the complex.

2. To identify positively the disease-causing agents and determine their characteristics.

3. To continue to check against the presence of rinderpest.

4. To develop simplified diagnostic procedures.

5. To develop immunizing biologics for the diseases.

6. To determine more definitely the incidence and geographic distribution of the diseases.

7. To develop prevention, control, and eradication methods.

In short, the research studies are aimed at developing knowledge about the component diseases of the complex upon which effective control and eradication methods can be based. Judging from experience with other animal diseases in the past and the progress made so far in current studies, disease eradication authorities and research workers are hopeful that the control of the mucosal disease complex will soon be possible.